AB-3 - Paper

Relationship between the Aviation Selection Test and a Psychomotor Battery

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ABSTRACT

The current selection tool used by the U.S. Navy and Marine Corps for its aviation officer program is a paper-and-pencil test that measures academic aptitude. There are no other tests in operational use that measure the psychomotor skills and cognitive processing skills that aviators need to fly. The Naval Aerospace Medical Research Laboratory (NAMRL) is currently evaluating the use of such a test. The purpose of this study was to establish the relationship between the paper-and-pencil Aviation Selection Test Battery that is currently being used and a Computer-Based Performance Test (CBPT). A factor analysis resulted in a four factor model accounting for 66% variance. The four factors measured by the CBPT and ASTB include tracking, quantitative skills, dichotic listening, and spatial abilities. Neither of the test batteries fully loaded on all factors. This indicates that while there are some similarities between the two test batteries (i.e. math skills, spatial apperception), there are also some important differences (e.g. dichotic listening and tracking) between the two test batteries. These differences may prove to be beneficial for future aviation selection tests.

INTRODUCTION

The current aviation selection tested used by the U.S. Navy and Marine Corps to select potential candidates is the Aviation Selection Test Battery (ASTB). This test is limited to the assessment of academic aptitude, spatial orientation, background and interests, and does not evaluate psychomotor skills or more complex information processing skills (Gibb & Dolgin, 1989).

The ASTB is a five part paper-and-pencil test that takes approximately 2 ½ hrs to administer. The first subtest administered is the Math Verbal Test (MVT). Candidates are given thirty-five minutes to complete thirty-seven items that concern math and verbal/reading comprehension questions. The second subtest is the Mechanical Comprehension Test (MCT). This portion of the test contains thirty questions that must be answered in fifteen minutes. The Spatial Apperception Test (SAT) is the third subtest administered. Candidates are shown the image of an aircraft and then five cockpit views and asked to determine which view would a pilot see if in that aircraft. Candidates are given ten minutes to complete the thirty-five question subtest. The Aviation and Nautical information Test (ANI) is the fourth subtest administered. This subtest asks questions that deal with aviation and nautical history as well as terms commonly used in these areas. Candidates are given fifteen minutes to complete thirty questions. Finally, there is a Biographical Inventory (BI). This test contains seventy-one questions pertaining to the

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individual's background and life experiences. They are given twenty minutes to complete this portion. A composite score is calculated using the five subtests. Applicants must meet a minimum requirement to be considered for training. Approximately 50% of the applicants are eliminated at this point.

The ASTB has been used in one form or another since the 1940s to screen applicants to the U. S. Navy's aviation training programs, with predictive validity, not corrected for range restriction, of between .25 - .40 (Frank & Baisden, 1992). The ASTB is validated to predict training up through primary. A combination of academic and primary flight grades are used a criterion variables.

METHODS

Participants

One-hundred and fifty U.S. Navy and Marine Corps aviation candidates, ranging in age from 21 to 31 ($M = 23.93$, $SD = 1.93$), from the Naval Aviation Schools Command (NASC) and the Marine Aviation Training Support Group (MATSG) volunteered over a two year period. The sample included 141 males and 9 females. Previous flight hours ranged from 0 to 2000 ($M = 70.92$, $SD = 226.20$).

Materials

The Computer-based Performance Test (CBPT) is a 2-h test battery that measures eye-hand-foot coordination (multitasking), spatial/mental ability, divided auditory attention, and cognitive skills. Similar to a video game run on an IBM- or PC-compatible computer (386/25 MHZ or greater), the system requires a VGA monitor, two joysticks, rudder pedals, numeric keypad, and headphones. The CBPT has several programmed test batteries that are predictors of student naval aviator and naval flight officer performance and attrition (Delaney, 1992; Street, Chapman, & Helton, 1993). The system has also been used for the Landing Craft Air Cushion Vehicle operators and engineer position training outcome (Dolgin & Nontasak, 1990; Nontasak, Dolgin, Blower, 1991; Robertson & Nontasak, 1996).

There are ten subtests within the CBPT. They are the stick (S) task, the dichotic listening task (DLT), the S and DLT simultaneously, the S and rudder task (SR), the SRDLT, the SR and throttle task (SRT), a horizontal tracking task (HT), and absolute difference task (AD), and the MANIKIN test.

Statistical Analysis

A Principal Component Factor Analysis was done, followed by the Varimax Rotation Method using SPSS 7.5.1.

RESULTS

The factor analysis resulted in four components, accounting for 66% of the variance. Looking at Table 1, we can see that the following variables loaded highly on the first

component: S (.841), SR (.873), SRT (.902). Several other variables loaded somewhat less on factor 1: SRDLT (-.591), SDLT (-.648), and HTAD (-.348). On the second factor, the following variables loaded: HT-AD (.566), MCT (.701), and MVT (.810). The DLT (.797), SRDLT (.551), and SDLT (.564) loaded on the third factor. Finally, MANIKIN (.666) and SAT (.747) loaded on factor four.

Table 1. Rotated Component Matrix

Variables	Component			
	1	2	3	4
D	-.114	.004	**.797**	-.003
HTAD	-.348	**.566**	.203	.113
MANIKIN	.001	.264	.328	**.666**
S	**.841**	-.008	-.001	-.009
SR	**.873**	-.135	-.007	-.101
SRT	**.902**	-.134	-.007	-.003
SRDLT	-.591	-.007	**.551**	.002
SDLT	-.648	-.001	**.564**	.139
ANI	-.139	.316	-.359	.424
MCT	-.145	**.701**	-.226	.200
MVT	.002	**.810**	.007	-.235
SAT	-.130	-.227	-.005	**.747**

DISCUSSION

Looking at those variables that loaded highly on factor one, it seems appropriate to call this factor "Tracking." Again, those variables were S, SR, and SRT. These are the stick, stick/rudder, and stick/rudder/throttle tasks, respectively. Two subtests that had a slightly lower loading was SDLT and SRDLT. These two subtests are multi-tasking tests that contain both a tracking component and dichotic listening. Therefore, it would stand to reason that they should load on a tracking factor. Finally, a slightly lower factor loading was the HT-AD. This variable was a composite of the horizontal tracking and absolute

difference subtests. While the actual loading is low, there is still a tracking component within the subtest.

The second factor seems to attract those variables that contain or require some mathematical skills. This can been seen in the fact that the MVT and MCT subtests loaded highly, along with the HT-AD loading slightly less. While the MVT is math and verbal, approximately 75% of the subtest is math. The MCT requires individuals to remember some formulas and do a little math, while the AD portion of the HT-AD subtest requires the individuals to take the absolute differences between two numbers. Obviously a math skill.

Factor three seems appropriately labeled "Dichotic Listening." Variable D loaded highly, SDLT, and SRDLT fairly well. DLT is purely a dichotic listening task and SDLT and SRDLT are multi-tasks that contain components of dichotic listening as well. Lastly, factor four appears to be a spatial ability or mental rotation factor with the SAT portion of the ASTB and the MANIKIN loading highly.

The ASTB and the CBPT have some commonalities, such as both seem to tap into quantitative and spatial abilities. However, the CBPT offers a very different perspective on aviation selection. The tracking and the dichotic listening tasks are similar to the real world environment of the aviator and do not seem to have common factors in association with the paper-and pencil ASTB. In the laboratory, we have consistently found that the incremental predictive validities (over and above the ASTB) of the CBPT using a flight performance criterion is highest for the combined tracking and DLT tasks.

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